



# TEACHERS GUIDE BIOLOGY



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# BIOLOGY

CSIRO's Double Helix Teacher's Guides are an assortment of articles and activities appropriate for use in the Australian classroom. Taken from Double Helix's publications, each resource is scientifically current and explicitly linked with the Australian Curriculum: Science. The classroom activities engage students in a range of skills to help develop their ability to think scientifically about the world.

Biology 2013 is just one of four Double Helix 2013 Teachers Guides. The Earth and Space, Chemistry and Physics guides also present topics that complement the Science Understanding strand of the Australian Curriculum: Science.

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**Demonstration**



**Comprehension**



**Hands on**



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**Teachers:** Read out the article below.  
Discuss with the students their experiences  
of wild animals and tame animals.

## AS TAME AS A FOX?

Silver foxes aren't likely to be found in your local pet store. Most live in the wild. But a long experiment in Russia has bred silver foxes that are as tame as dogs.

A Russian scientist called Dmitry Belyaev wanted to find out how domestic animals could have evolved. So in 1959 he set up an experiment to try and tame the silver fox.

Dmitry started by selecting foxes that were the least afraid of humans. When those foxes bred, their babies were also tested for friendliness toward people. Dmitry died in 1985, but his research has continued. After picking and breeding the friendliest foxes for about 50 years the researchers can see clear signs of a domesticated animal.

The domesticated foxes behave in a 'dog-like' way. When people approach them they wag their tails and whimper excitedly. They even jump up and lick faces just like a dog!

Not only are they less aggressive, the foxes sometimes have floppy ears and curly tails. Some even have black and white coats like border collies.

*Scientrific* September – October 2012



### Puppy power

In each box below, draw a mother and a father dog. Make them look different.

Now draw some puppies. How might they look? Are they all the same, or are they a little bit different?

## FIVE TIPS FOR KEEPING HERMIT CRABS

1. The hermit crab's habitat is tropical, so you'll need a heat pad under your tank to keep it between 22 and 27°C. Use a thermometer to keep track of the temperature.
2. Use two water dishes – one for fresh water (for the crab to drink) and one for salt water (for the crab to walk through).
3. Hermit crabs breathe using gills, so it's a good idea to spray a light mist into the tank every now and then to keep it humid.
4. For their lunch, hermit crabs eat both meat and vegetables. Every day, drop in some fresh fruit and a handful of special hermit crab food pellets.
5. If your pet crabs are still growing, you'll need to provide them with extra shells to move into.

*Scientrific* November – December 2012



Draw a picture of a hermit crab tank below.

Discuss setting up a hermit crab tank with your teacher. How would you look after them?

## FIVE FACTS ABOUT OUR FEATHERED FRIENDS

1. Birds make up a class of vertebrates called Aves. All members of this class have three things in common; they all have feathers, hard shelled eggs and hollow bones.
2. Birds sing at dawn more than any other time of day, and do it without vocal chords. Songs are made by running air from the lungs through a chamber called a syrinx (SE-rinks), causing membranes to vibrate.
3. Birds mostly sing to defend their territory and attract mates. This means it's often the male who sings.
4. Australia is home to about 740 native bird species. Currently, about one fifth of these species are threatened with extinction, mostly due to loss of habitat.
5. Pet birds get more infectious diseases than other common pets. While owners might love their pets, they often risk causing their birds problems by only feeding them dry seeds. High in fats and carbohydrates, it's like a human living off little more than hot chips.

*Scientrific* January – February 2013



### I'm not a bird!

Can you come up with some ideas that fit these descriptions?

I can fly, but I'm not a bird:

I have a beak, but I'm not a bird:

I have two legs, but I'm not a bird:

I eat worms, but I'm not a bird:

I lay eggs, but I'm not a bird:



**Research:** Birds belong to the Class Aves. Humans belong to the Class Mammalia. Describe all the ways mammals are different to birds.



## INSECT INSPECTION

Creeping, crawling, flying, buzzing, clicking – you see and hear insects every day. More than one million different species of insect live on our planet, and they're just the ones we know about! In fact, half of all species on Earth that have been described by science are insects. We can explore their huge range of colours and shapes with insect collections.

### Is it an insect?

It is really easy to spot an insect – just remember the rule of three. Their bodies are made of three segments and they have three sets of legs. Add a pair of antennae and you have found an insect.

Some insects might be hard to identify because their bodies are covered by wings, like the ladybird beetle. Don't worry, the antennae are easy to see.

Another feature of insects is that they have no backbone inside their body. Instead, they have an exoskeleton – the outside of their body is made of a really strong material called chitin (KY-tin) that gives them strength and protection.

### Big in Australia

The Australian National Insect Collection has the largest collection of Australian insects and related groups. It started in 1929, and today contains over 12 million insects, mites, spiders, earthworms and centipedes in its collection, with 100 000 more added each year. It is managed by CSIRO, but scientists all around the world use this collection for their research.

*Scientrific March – April 2013*

## Catching the bug

**Safety:** Some bugs (including spiders, scorpions, centipedes and some insects) can sting or bite. Make sure you wear gloves and avoid touching any bugs that you find.

### You will need

- Large plastic containers
- Rake
- Gardening gloves
- Tongs
- Paper
- Pen

### What to do

1. Find a place outside that has lots of leaves on the ground.
2. Rake up a small pile of leaves.
3. Put on the gloves and fill one of the containers with the leaves.
4. Leave the container in the sun for half an hour.
5. Put the lid on the container and shake.
6. Open the container. Using the tongs, look through the leaf litter and see if you can find any bugs, such as insects, spiders or worms. Make sure you look closely, as some might be small.
7. Write down all of the bugs you find. If you don't know what type of bug it is, write down a description to investigate later.
8. When you think you've found all your bugs, return the leaf litter to where you found it.
9. You can also try collecting leaf litter from different places and comparing the types of bugs you find there.

### What's happening?

Leaf litter is an important habitat for many types of invertebrates, such as insects. Leaves provide food for some species, while others use the leaves to hide from predators. Leaf litter can also keep the bugs cool and sheltered from the sun.

Can you describe the insects? Which are similar? Which are different?

*Science by Email*



## MAKIN' EGGS

All living things have a special chemical code that guides how their bodies are built. These codes are called genes. For example, some genes create brown colouring for eyes and hair. There are genes for spotty or stripy fur, and genes that control your height.

Every new cell an animal grows contains a full set of these codes. Most sets are made up of half of their mother's genes and half of their father's genes. That means adult animals need to produce special cells that contain only half of their genetic code in order to make a baby.

In female animals these special cells are called ova (oh-va), or 'eggs'. In male animals these special cells are called sperm.

When an ovum and a sperm join together (called fertilisation), the two groups of genes combine to make a full set, creating a unique animal or person.

### Eggsamples

Oology (oh-ol-o-gee) is the study of eggs, describing how they are made and how they differ between animals.

Animals reproduce in many different ways. In most mammals, fertilisation happens inside the mother. Their eggs are extremely tiny and unprotected by a hard shell. The fertilised egg buries into an organ called the uterus, where the mother's body feeds the developing baby.

In monotremes (such as platypuses and echidnas), birds and reptiles, the egg is a little different. While the egg still gets fertilised inside the mother, the baby develops outside. It is covered by a thick shell for protection. The egg contains all of the nutrients necessary to feed the young animal as it grows.

Fish and amphibians are different again. Most lay their eggs before fertilisation. The male then fertilises them in the water outside of the mother's body where they continue to develop.

### Ova and out!

The egg most of us are familiar with is the one that tastes nice with bacon. It consists of a shell, a white part and a yellow or orange centre.

A hen takes between 23 and 26 hours to prepare an egg for laying. An organ called the ovary stores a number of small eggs. It grows and releases them one by one in an event called ovulation. At this point, however, the egg is just a ball of yolk – round and light orange.

The egg travels through the hen's reproductive system where a coat of albumin is wrapped around the yolk. This coating is what you see as an egg-white, and it protects the developing young. Fertilisation can take place here if there is sperm present.

However, the eggs we eat are not fertilised. On commercial egg farms the male and female chickens are kept apart. Without fertilisation, the egg continues to form without a chick.

The egg then moves into the shell gland where it sits for 18 to 20 hours while a hard shell forms. The shell is made-up of calcium (just like our bones) and a salt called carbonate. Both chemicals are dissolved in the chicken's blood. When they are mixed together in the shell gland they produce a hard material called calcium carbonate, much like how crystals form. Sometimes brown pigments are added, giving speckles or a brown tinge to the egg.

The growing chick might have all of the nutrients and water it needs inside the egg, but it still needs to breathe. Fortunately the shell has thousands of tiny holes in it to let air move through it. To stop dust and bacteria from getting in, a thin layer of protein called 'bloom' is painted over its surface as it is being laid.

## Sunny side up

Humans have been eating eggs for thousands of years. Not only are eggs a good source of protein and fat, they don't run very fast or bite back!

The eggs we most commonly eat are from a species of bird called *Gallus domesticus* – or the chicken. Today's chook is descended from species of jungle fowl found in Asia, and has been bred for meat and eggs for thousands of years.

Chicken eggs contain important nutrients such as protein, folate, iron and a number of vitamins. In fact, they are one of the few foods we eat that provides Vitamin D.

So, however you like your eggs – boiled, fried, poached or scrambled – remember that while they are tasty and nutritious they also serve an important role in animal reproduction.

*Scientrific* May – June 2012



## Circle of life

1. Cut out the following words and pictures.
2. Arrange the pictures on a sheet of paper to show the life cycle of a chicken.
3. Connect the pictures by drawing arrows.
4. Label the pictures using the words.

ova

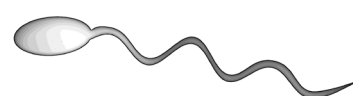
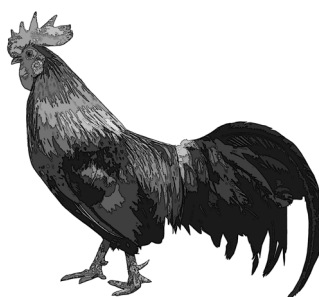
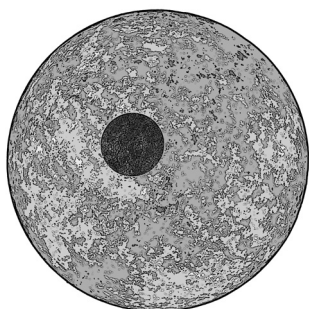
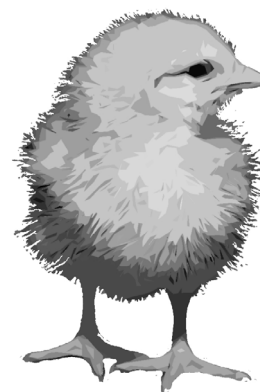
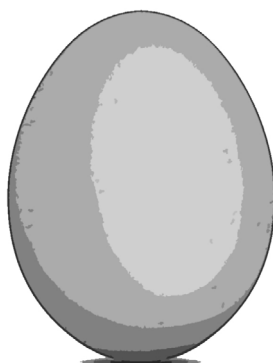
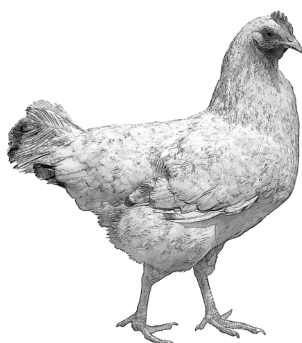
chick

sperm

egg (laid)

male

female





## START WITH A SEED

A seed is like a baby plant that has not been born yet. Collecting seeds is an important part of understanding plants and trees.

The study of plants is called botany and began with people trying to work out what plants were edible, poisonous or could be used for medicine. If plants were edible, their seeds were collected and used to grow gardens and crops.

### A seed's parts

A seed contains a baby plant, some food and the seed coat. The seed coat is the outside shell of the seed and helps to protect the plant inside. The food is inside the seed coat and will feed the baby as it grows into a seedling.

### Seeds love to travel

As plants cannot move, they rely on other ways of spreading their seeds far and wide. The main ways seeds travel are by wind, water and animals.

Dandelion seeds have hairs to help them float on the wind.

Some seeds, such as coconuts, float in water so they can easily be carried by rivers and oceans to wash up on far-away beaches.

If you look in your fridge, you may even find some seeds hiding inside fruit such as cherries, peaches and grapes. Animals, including humans, eat the fruit and drop the seeds far from the parent tree.

We eat many different seeds every day. Wheat, rice and oats include seeds of different species of grass, and can be made into breakfast cereal and flour. Beans such as chickpeas, lentils and peas are soft seeds. Nuts are also seeds; but to eat nuts, you take off the hard shell and eat the part inside.

## Exploring seeds

Collecting seeds was very important to botanists in the early days of exploring. Joseph Banks travelled with Captain Cook on the ship *Endeavour* from 1768-1771, collecting many Australian plants and seeds and taking them back to England. Allan Cunningham travelled through New South Wales in the 1820s collecting plants and seeds while exploring this new area. Both Joseph and Allan have plants named after them, and one plant is named after both of them, the *Banksia cunninghamii*.

## Start your own collection

You can start your own seed collection by stepping into your garden, visiting a local park or going to a garden store. You can keep your seed collection in a container. One with many compartments is useful, as you can keep each seed in a different compartment; or, you can keep them in small sealable bags.

If you like to draw, keep a journal and draw pictures of seeds. Whichever way you choose to keep your collection, make sure you write down the name of the plant each seed is from.

*Scientriffic* September – October 2012



## LIFE OF BUGS

### You will need

- Live mealworms (from pet shops)
- Potato pieces
- Plastic container with a lid
- Nail
- Oats or bran

### What to do

1. Use the nail to poke some holes in the lid of the container.
2. Half-fill the container with oats or bran and add a piece or two of potato.
3. Add the mealworms to the container.
4. Put the lid on the container.
5. Check on the mealworms every day for three to four weeks.
  - Record how the mealworms change by drawing them or describing their features.
  - Record the times and dates of your observations.

### What's happening?

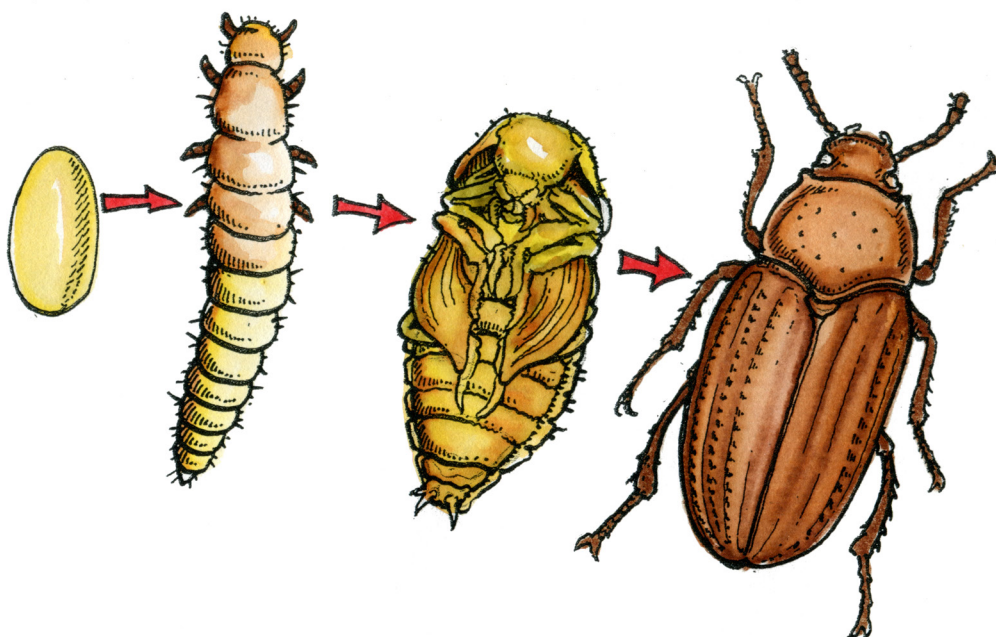
Many insects have a life cycle that consists of distinct stages. The mealworms you start with are the larval stage, which hatch from eggs. As the larvae grow, they shed their hard exoskeleton when it no longer fits. Eventually, instead of just shedding their exoskeleton, the larvae turn into pupae.

Pupae are largely inactive – at this stage, the insects don't feed or move around much. After a period ranging from days to weeks to months, the adult beetles emerge from the pupae. The adult beetles look very different from the larvae and the pupae.

*Science by Email*



**Research:** Can you label the following life stages of a beetle?



## THEY'RE BEARLY COUSINS!

The word 'Arctic' come from the Greek word for bear. You might think it relates to the North Pole's polar bears. However, these big, white-furred predators weren't always at home in the icy wilderness. Tens of thousands of years ago, brown bears and polar bears were the same species.

At some point, some of the bears' ancestors slowly evolved features that made it easier for them to get food in a frozen climate. Their skin darkened to absorb warmth; their hairs became hollow, refracting the light to give them better camouflage; their feet widened to help them swim and walk on the snow. Today, you wouldn't mistake a polar bear for its brown 'grizzly' cousin.

Scientists first thought they went separate ways only about 120 000 years ago. That might seem like a lot of birthdays, but in thinking about evolution, it's a blink of the eye! Taking a closer look at their genes, however, showed they took a bit longer to evolve – they split up about 600 000 years ago.

The big question now is, how will polar bears survive if the Northern polar ice shrinks? While they've survived warmer periods before, nobody is sure how they'll deal with climate change this time.

*Scientrific* July – August 2012



### Alien adaptations

A niche (NEESH) describes an organism's place in its ecosystem, such as where it rests, how it gets its food, and how it affects other living and non-living things.

Polar bears are well adapted to their niche. Their colours help them keep warm and camouflaged and the shape of their feet helps them hunt, swim and walk on snow.

In the space below, draw an alien that is suited to one of the following niches:

- Lives on a beach, eats tiny seeds, shares habitat with flying predators.
- Lives on rocky hills and cold mountain tops, eats tough fungi that grow on rocks, shares habitat with packs of tiny predators.
- Lives in the open ocean, eats birds that land on the surface, shares habitat with massive carnivorous fish.



## ALIEN INVADERS

### You will need

- Standard draughts/checkers board (with 64 squares)
- 12 round markers (of one colour)
- 12 round markers (of another colour)
- Glue stick or Blu-tac
- Scissors

### Background

Before playing the game, revise the basic rules of draughts/checkers. A good explanation can be found here: <http://bit.ly/a387P0>

### What am I learning?

How exotic species are able to spread quickly in new environments.

### Introduction

In the following game, you will model a made-up situation to learn more about the effects of an alien species on native species in a habitat. This scenario has four similar species: each with a different advantage, and all competing for the same resources in a habitat. One of the four species is an alien species. The rest of the species are natives. At the start of the game, the four species have the same numbers of individuals in the habitat. Each of the native species dominates, and is dominated by, another native species.

Species	Origin	Traits	Competition
1	Native	Reproduces all year round	Beats species 2
2	Native	Can move very quickly	Beats species 3
3	Native	Can eat a wide variety of plants	Beats species 1
4	Alien	Has no predators; eats everything	Beats all species

### What to do

1. Find a partner and choose which colour markers you will each play with.
2. Cut out the circles with the numbers on the opposite page.
3. Put the 24 circles face down and shuffle them.
4. Randomly pick 12 circles each. Put Blu-tac or glue on the side opposite the number. Without showing your partner, stick one number onto one side of each of your markers.
5. Place the markers (with numbers face-down) on the first three rows of the board on their corresponding squares, as you would for a normal game of draughts.
6. Choose who will start first. Move your marker one square diagonally, as you normally would in draughts.
7. Keep taking turns until you or your partner are in a position to jump another piece. This is called an interaction. When you are in this position, both you and your partner should turn over the markers to display their numbers. The person who wins the interaction is the one whose number dominates the other. The marker that wins the interaction can now move diagonally one square in any direction. In cases where both markers have the same numbers, the normal rules of draughts apply.
8. In the table on the next page, record the outcome of each interaction, including those between the same species.
9. Continue playing until one player wins by capturing all of their opponent's markers, or by blocking their opponent so they cannot make a move.

Which species was the most successful? Why?

Versus	species 1	species 2	species 3	species 4
species 1				
species 2				
species 3				
species 4				

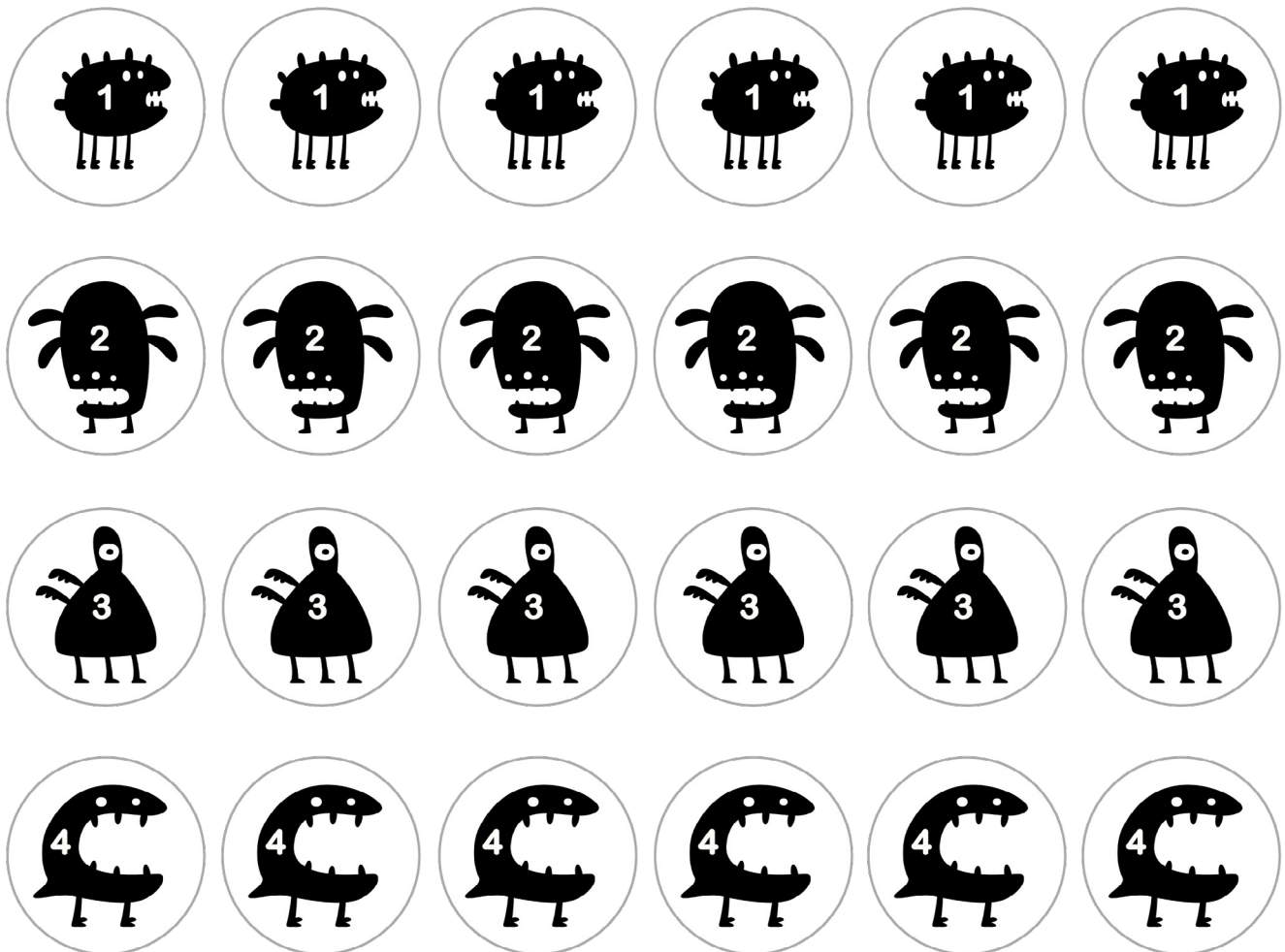


Image: Thinkstock



## ALBINOS

Whether it's a peacock's plumage or a tiger's stripes, the animal kingdom is full of colourful patterns. But some animals have a unique uniform – one that is all white.

Melanin (MEL-ah-nin) is a pigment in animals that gives skin, hair, feathers, scales and eyes their dark colouration. Without this chemical, animals are described as being albino (al-BEE-no).

Albino animals appear mostly in shades of white, with red or pink eyes and pink skin. The trait is caused by differences in the animal's genes, so is often passed from parents to their children. Albinism (AL-bin-IS-m) can occur in any species that produces melanin, including humans.

### Are all white animals called albinos?

Some animal species, such as polar bears, evolved ways to stop producing certain pigments to blend into their habitat. Since they still make melanin for other parts of their bodies, they technically aren't albinos.

Even in other species, having less pigment doesn't always make an animal a true albino. Some pale or patchy animals have partial albinism; they might be

mostly white but have some coloured patches or coloured eyes.

The easiest way to determine if an animal has true albinism is to check their eyes. The irises and pupils of most albino animals look red or pink. Without melanin, the red colour of the blood vessels inside the eyes shows through. In humans, just enough melanin is usually made for irises to look pale blue.

### Standing white out

Albino animals such as whales and peacocks may be rare, but in the wild they can be an easy target. Many animals use their colours as a camouflage to hide and escape from predators. For hunters with albinism, stalking prey can also be tricky when you stand out against the background.

This is not the only hardship that animals with albinism face. Melanin provides a natural defence against the harmful effects of ultra violet radiation. Albino animals have no melanin and have a greater risk of developing skin cancer or suffering damage to their eyes.

*Scientrific* September – October 2012



### Just the facts

1. Which pigment gives animals their dark colours?
2. True or false: there are no humans with albinism.
3. Dark pigments help camouflage animals. What other advantage does it give?

### Big tricky question

4. Albino animals don't tend to survive for long in the wild. Describe some conditions in an environment in which albino animals would have a better chance of surviving than their relatives.

## SALTY PASTA WHEAT

The wild ancestors of wheat had some good adaptations for living in tough environments. But modern wheat varieties have characteristics that make harvesting the grain easier. For example, modern wheat grains separate from their husks more easily than ancestral wheat grains.

In Australia's harsh environment, wheat needs to be both easy to grow and easy to separate. By crossing a modern variety of pasta wheat with an old relative called Einkorn wheat, researchers have bred a new variety of pasta wheat that can grow on salty soils.

To breed a good crop for farmers, the scientists needed to keep Einkorn's salt tolerance, but all the other characteristics needed to be like pasta wheat. They used several generations of cross

breeding to get this combination. Genetic tests helped them check for the salt tolerance gene in each generation, making sure they weren't weeded out.

The scientists found that the wheat could grow on salty soils by keeping salt out of its leaves. Too much salt in leaves stops photosynthesis, giving plants too little energy for growth and development. One of the Einkorn's genes operates in the roots to filter the salt out, stopping it from getting into the water pipes that lead to the leaves.

CSIRO scientists ran field trials to test the new wheat on a farm. They found that it produced more grain than regular pasta wheat on salty soils, and the same amount on normal soils.

*The Helix* August – September 2012



### A grain of truth

Wheat is an important crop not just in Australia, but throughout the world. While it provides energy for millions of people, there's a lot more to this simple grass than first appears.

Use your research skills to correct the following statements:

1. Humans have been farming wheat for millions of years.
2. Wheat is a type of algae.
3. Wheat can be ground into sugar.
4. Gluten is a type of fungus that is produced by wheat.
5. Rust is a type of insect that destroys wheat crops.



## SEEDS OF SCIENCE

### Background

All living things require certain things to grow and remain healthy, such as nutrients, an energy source and water. But there is also too much of a good thing!

Conduct an experiment on a developing plant to determine the best conditions for its growth. Use water cress or radish seeds for the best results.

### Variables

Every time you do an experiment, parts of it can be different. These differences are called variables.

- Some parts of an experiment you want to change.
- Some changes you will want to measure.
- Some things, however, you will want to stay the same.

### In my experiment, I will change (tick a box):

a) The amount of salt in the soil	
b) The amount of sand in the soil	
c) The amount of water	
d) The amount of sunlight the plant gets	
e) The temperature of the developing plant	
f) The amount of light the developing plant receives	

### What am I learning?

Experiments are about changing one variable to see how it affects another.

### In my experiment, I will measure:

The rate at which the plant grows.

### In my experiment, I will keep the same:

(List all of the things you will keep the same)

### Trials

In an experiment, each time you change a variable, you do a trial. You can do trials together, but they should all have one thing different.

- How many trials could you do?
- How will each trial be different?

Handy hint: It's a good idea to pre-test your variable to work out what will stop your plant from growing. It's no good having all the plants die because they all have too much salt!

### Hypothesis

A hypothesis describes what you predict will happen. It's worded so your experiment can show it to be right or wrong.

As I increase \_\_\_\_\_  
(describe the variable you changed), the plants will grow faster/slower.



For more resources to assist in developing a scientific investigation, including planners, visit [www.csiro.au/crest](http://www.csiro.au/crest)

## FAR FROM HOME

Australia is home to hundreds of exotic species that have been introduced over the past two centuries. Many of these introduced species have become major pests. But, back in their natural habitat, most of them aren't causing the same problems. In fact, some countries are having their own trouble with exotic species from Down Under.

### Getting around

Humans can introduce Australian animals and plants to new countries intentionally or accidentally.

Australian species have been introduced overseas on purpose to start new industries, such as timber and fur, as well as providing food and other resources for people. Plants have also been introduced because they look great in a garden. Many Australian plants have gone wild overseas after spreading beyond the areas where they were originally introduced.

Some Australian species have sneaked into their new homes accidentally by 'hitching a lift' in cargo ships or planes. Many insect invasions around the world have started this way, while Australian marine species are likely to arrive in a ship's ballast water. Birds and mammals are sometimes accidentally released from zoos and aviaries.

Once inside a new country, species can spread and cause a whole range of problems.

### Our best and worst export

Although only a few species of *Eucalyptus* naturally occur outside Australia, many species have been successfully introduced around the world.

Many countries, such as Brazil and India, have huge eucalypt plantations that provide timber and fibres to manufacture paper. Planting eucalypts in other countries can offer other environmental benefits, such as providing windbreaks, reducing erosion and saving native forests from being logged.

Unfortunately, eucalypts are not all good news. In many areas, they are now classified as invasive.

Eucalypts were taken to South Africa in the 19th century to provide timber, but have since spread and are causing some serious environmental problems. They have a bad reputation as water guzzlers, and they take over habitats by preventing the growth of native plant and grass species.

Large numbers of *Eucalyptus* trees in Southern California release flammable oils into the air, making wildfires more frequent and intense. These hotter fires destroy native plant species, reducing biodiversity.

### Wandering wallabies

Two red-necked wallabies escaped from a wildlife park on the Isle of Man, an island in the Irish Sea, about 50 years ago. Today, around one hundred of their descendants live in the wild on the island. Thousands of kilometres from Australia, they are thriving on grass, rushes and reeds, and so far aren't posing any problems for their new home.

It's a different story in Scotland, however, where a population of around 50 red-necked wallabies are living on a small island in the middle of a lake. The wallabies have been gobbling down too many of the island's native plants, allowing noxious weeds to grow. Their overgrazing is also making life difficult for the native deer population. Authorities plan to remove the wallabies from the island.

### Pests in training

A 'naive population' is a group of animals or plants that hasn't been exposed to a new risk (such as a disease, plant or animal) before. This means that the population hasn't evolved a way to protect itself, making it more vulnerable to new threats. Many factors can transform an Australian species from an exotic Aussie to a pesky pest.

### Unwanted baggage

Introduced Australian species sometimes have travelling companions that tag along for the ride. Plants that have been intentionally introduced might also bring with them unwanted exotic

organisms, such as insects or fungi. Exotic animals can carry diseases, making other animals and humans sick. For example, some of the brushtail possums living in New Zealand are infected with a bacterial disease called bovine tuberculosis, which they can pass on to cattle. Australia has no infected possums.

The actions of invasive species both here and abroad can have serious consequences. However, sometimes it's difficult to control the movement of species.

### Insects against intruders

In southern Florida, the Australian broad-leaved paperbark tree, or *Melaleuca*, is classified as a noxious weed. It was introduced to the United States more than 100 years ago as an ornamental plant.

*Melaleuca* trees have invaded Florida's Everglade wetlands and replaced native plant species by

outcompeting them for water and nutrients. Huge amounts of money have been spent to try and remove paperbarks from the wetlands.

The latest tactic in the war against the paperbark is the use of two Australian insects as biocontrol agents: a weevil that munches on *Melaleuca* leaves, and a psyllid that sucks their sap.

After extremely careful research by scientists at CSIRO and the United States Department of Agriculture, authorities released the insects in southern Florida. They have been successfully established across the wetlands, drastically cutting the number of invasive paperbarks in many areas and improving the Everglade wetland ecosystem.

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### FRIEND OR FOE?

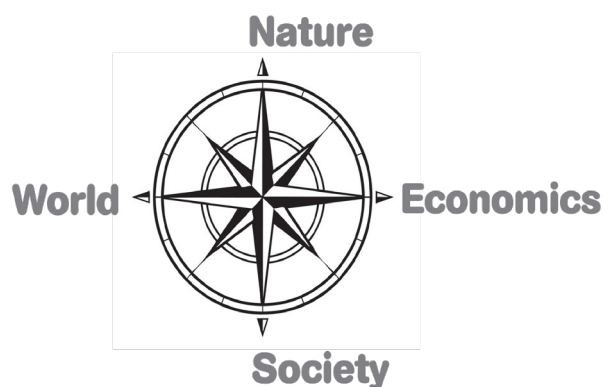
Read 'Far from home' and write down a list of facts, ideas and issues you'd like to know more about under the following four headings:

**Nature:** The environment and ecosystems that surround us.

**Economics:** Our resources, trading and our way of calculating costs.

**Society:** Our personal beliefs, values and community needs.

**World:** The beliefs, values and community needs of other cultures.





## MAMMALS' PAST REVEALED IN A BUMPY BITE

65 million years ago, dinosaurs ruled. Then an asteroid wiped them out, clearing the way for mammals to take over. Or so the story goes.

An evolutionary biologist from Monash University questions if that story really explains the diversity of mammal species. He points to the teeth of a rodent-like group of animals as evidence supporting another idea.

The teeth belong to a group of extinct mammals called multituberculates, a word that means 'many bumps'. By comparing teeth taken from 48 species of multituberculate, the researcher was able to roughly sketch out this ancient mammal's family tree.

About 170 million years ago, bumps on the multituberculates' teeth were quite simple. Then, about 25 million years before the dinosaurs went extinct, they became more complex.

Changes in teeth usually indicate a change in the food an animal eats. In this case, a more complex pattern of bumps could indicate a diet containing more plants. Being able to chew on a readily available food source could have given multituberculates an advantage long before the dinosaurs vanished.

While it's likely the dinosaur's departure gave mammals a helping hand, this research shows they were well prepared to take a bite out of the world on their own.

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### Tooth design

Teeth perform a variety of jobs to help animals not only chew their food, but to kill prey, slice up vegetation, shatter bones and ward off predators. To do this, they come in many shapes and sizes.

**Draw a tooth shape that would be required to do the following jobs.**

Cut through meat	
Hold onto slippery food	
Grind up tough seeds	
Dig through dirt	

Can you find pictures of animal teeth that are similar your drawings?



## A FAMILY OF MONSTERS

To determine a category an animal in the past, taxonomists (scientists who classify living things) would need to take a close look at characteristics such as teeth, body coverings, and patterns of colour. While some categories are easy – such as telling a cat from a dog – others could be quite tricky.

These days, genetics can help tell you who's who. But there can still be arguments about how two living things are related.

Come up with some categories of monster for these creatures.

How might they be related?

Which monster/s belong in which group?

Why?

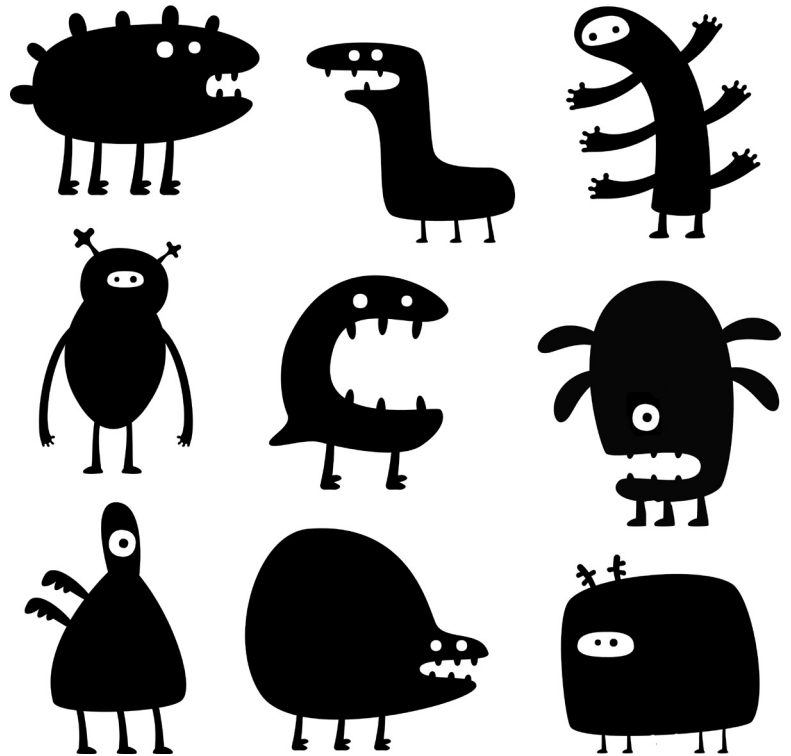
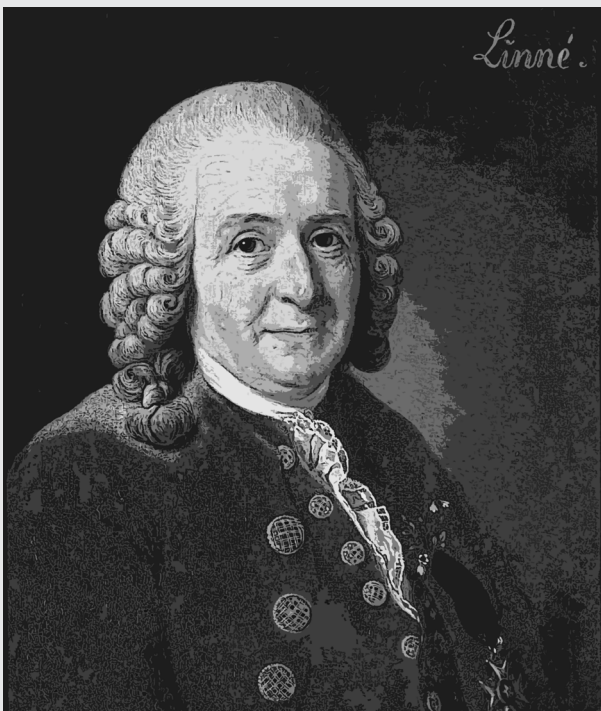


Image: Thinkstock



### The man of many names

Living things today are classified using two names: their genus and species. Humans, for example, are *Homo sapiens*. This 'genus–species' name was based on the work of a Swedish man by the name of Carl Linnaeus.

Genus and species are just two categories – can you list another five?

## FAUXNA

The sign on the giant block of ice read, “Most advanced alien life form ever discovered.” When Kelly squinted through the distorting ice, she could see fins and smooth blue skin and large eyes, like a dog-sized dolphin. It could have been something out of a family movie.

Kelly was the youngest scientist on Europa station, and although she was excited to study alien life forms, she didn’t like this one at all.

Next to her, Cynthia, the station’s visitor centre manager, grinned with excitement. “It looks perfect!” She noticed Kelly’s disgust, and patted her on the head. “I don’t expect you to understand. It’s a grown-up thing. You’re just here for the summer, and then you get to go back to Earth. The *real* scientists here don’t have that luxury.”

“What happened to the previous display?” Kelly asked. “The one with the microscope images of *Xenolutum primus*?”

“Visitor feedback said it was ‘too slimy’, and the exhibit was boring. We removed it.”

Kelly was about to argue, but Cynthia cut her off. “If we don’t increase visitor numbers, Kelly, we lose funding for the research. You can keep studying those boring slimes you discovered all you like when you get back to Earth, but there are lots of important things we adults have to consider.”

Kelly was angry now. “The slime moulds are alien life: real, exciting, life. It’s not our fault these tourists don’t like them. That doesn’t mean we need to—”

Cynthia interrupted again. “You have one room with pictures of fifteen different kinds of grey slop in them. You can’t blame them for getting bored. That’s why I think we need this ... thing!” She waved a hand at the giant ice block with the strange dolphin-alien at the centre.

“But it’s cheating!” Kelly yelled. Cynthia looked at her as though she was speaking a foreign language. “It’s just plastic and glue and bits of

cloth. If it wasn’t in the block of ice, everyone would see the stitches! I know you need money, but we can’t fake something this important just to get more visitors.”

“I think you can go now, Kelly,” Cynthia said. “We’ll finish preparing this display for the Earth Council delegation arriving tomorrow.”

Kelly was forced to stand with Cynthia and the scientists as a group of officials in fancy suits wandered through the visitor centre. They each made small ‘hmm’ sounds – but the wide-eyed blue dolphin held their attention.

“Wow. Ok,” one lady said. “More amazing than I expected. Yes, it’s definitely time to shut this place down.”

Cynthia nearly dropped her welcome sign.

“W ... why?”

“Earth Council passed the Protect Alien Life Act after hearing about your ... discovery. Any complex life forms are to be left alone, so we don’t interfere with their ecosystem. I’m delivering your notice in person.”

Kelly said nothing, but she could feel a smile forming on her face.

Cynthia gathered her composure. “Oh, that creature? Oh no, it’s uh, it’s not real. It’s just a prank to keep us entertained. A misunderstanding. Tell them, Kelly, you like messing around and making funny fake fossils, ha ha!”

The lady glared at Kelly. “Is this true?”

“Don’t ask me,” Kelly said. “I’m only here for the boring old slimes.”

THE END

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## That's debatable

Cynthia and Kelly disagreed over the ethics of making a fake alien. Who is right?

- Team Cynthia: Consider Cynthia's position – without money, there is no research. Can you come up with a convincing argument to show why it was a good idea to build a fake alien?
- Team Kelly: Consider Kelly's position – cheating is still cheating. Can you come up with a convincing argument to show why it would be a bad idea to build a fake alien?

Prepare your debate. Each team has between two and five minutes to argue why they are right. Those who aren't on the team can decide which argument is more convincing.



## Critical chain

There are pros and cons for searching for life on other planets, depending on what you feel is important.

In the table below, state a reason arguing why searching for alien life on another planet or moon is a good idea, and then counter it with an example of why it is a bad idea.

Under each argument, state the argument's core value (for example, does the argument value knowledge, wealth, preserving nature, preserving people's health, etc.).

	Yes, but...	
<b>Value:</b>		<b>Value:</b>

	Yes, but...	
<b>Value:</b>		<b>Value:</b>

	Yes, but...	
<b>Value:</b>		<b>Value:</b>

## WRITTEN IN BLOOD

Vampires might be the stuff of legends, but there are some who do make a living sucking blood. And it's a good thing, too; your blood contains clues that reveal a lot about your state of health.

Phlebotomy is the practice of drawing blood out of a vein. In the past, doctors would drain large amounts of a patient's blood in the belief that it would balance their body's fluids, or 'humours'. Today, phlebotomy is mostly done to remove small amounts of blood to test in a laboratory.

### You're so vein

Phlebotomists collect blood samples from veins and send them to a pathology clinic to be tested by a scientist. In some situations, such as when a patient's blood oxygen needs to be tested, blood will be carefully taken from an artery.

Some tests count the cells in blood, and others look at the watery liquid 'plasma' that surrounds them. To provide scientists with the best blood samples, phlebotomists collect blood in different 'vacutainer' (vacuum container) tubes.

- **Serum separation tubes:** contain a gel that traps blood cells underneath, separating them from the clear plasma.
- **EDTA tubes:** are small, with a purple lid. They contain a chemical that stops blood from clotting, allowing scientists to count the red blood cells easily.
- **Tri-sodium citrate tubes:** are small with a blue lid. They contain a chemical that helps scientists determine the time it takes for the blood to clot.

### What's the diagnosis?

Doctors often use samples of your blood to monitor what is happening inside your body.

Scientists can do a range of tests to provide them with clues.

- **Full blood counts:** counting the number of red blood cells, different types of white blood cell and smaller cell fragments called platelets. Too

many white blood cells can indicate an infection.

- **Electrolytes:** measuring the ratio of positive and negative ions in your blood. Ions include sodium, potassium and chloride, as well as dissolved carbon dioxide.
- **Liver function tests:** your liver produces a range of enzymes that help build up and break down chemicals in your body. This test makes sure your liver is fighting fit.
- **C-reactive protein (CRP):** released when cells in your body are damaged, high CRP levels can indicate an infection, or certain types of tissue damage.

### Taking a wee look

It may be less appetising to vampires than blood, but urine can tell a physician a lot about their patient's health.

Urine is created by the kidneys. Here, blood is pushed through capillaries that surround tiny looping tubes called nephrons, which filter water, salts and other materials. The liquid is full of urea – the end result of proteins that have been broken down into a nitrogen compound.

Ideally, urine should be a light straw colour, sterile and free of crystals. In the past, a physician would look at the colour of a patient's urine, have a smell, and sometimes even sip a little bit of it! If it was sweet, it indicated too much sugar had collected in the urine, which suggested diabetes.

Thankfully, today a medical scientist will use a microscope and special dipsticks to test a patient's urine. Signs of blood cells suggest an infection, while crystals might signal other health problems.



## Life in the lab

Doctors often rely on a lot of information from different scientists to make a diagnosis. While a lot of these scientists test your blood, others use different samples to investigate your health.

**Microbiologists:** test samples of urine, faeces, blood, phlegm... nearly anything your body produces, to determine what bacteria, fungi or parasites are making you unwell.

**Immunologists:** measure the levels of proteins called antibodies in your blood. These antibodies stick to nearly anything they don't recognise as part of your body and label them as 'invaders'.

**Biochemists:** detect and measure chemicals such as enzymes made by your liver or glucose levels in your blood.

**Haematologists:** if you think seeing one blood cell means you've seen them all, think again. Haematologists time how long it takes for your blood to clot, and count the white blood cells floating through your veins.

**Cytologists:** cancers are sometimes known as silent killers, but to scientists, they can be anything but sneaky. To a trained cytologist, a cancerous cell can stand out like a sore thumb!

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## The health jigsaw

Choose from one of the following illnesses, or find another medical condition to research.

- Diabetes
- Celiac
- AIDS
- Alzheimer's
- Alopecia

Answer the following questions on your choice of condition:

- 1) How is this condition diagnosed?
- 2) What specialist/s is/are responsible for diagnosis?
- 3) Can it be treated? How are symptoms eased?
- 4) What cells, tissues or organs does it affect?
- 5) How does it affect the lifestyle of people who have this condition?

Create a poster displaying what you've learned.

## SKIN DEEP

Pale, tanned or dark. Soft, rough or smooth. Freckled, clear or wrinkly. We all have it: and it's more than just a cover for our insides.

As your largest organ, think of your skin as the first line in your body's defence system. Not only is your skin an almighty protector, it's a sensor, an insulator and a communicator. Looking after your body's outer layer just might save your skin.

### The armour

The epidermis is your first layer of skin. Much like a suit of armour, it's also your body's first line of protection. But, it too has its own layers; what you usually see is only the top.

The surface layer is made up of dead cells. Though this might sound gross, this dead tissue does an important job. As the bottom layer of the epidermis (called the basal layer) makes new skin cells, it pushes the old cells up to the surface. The flat, dried remains of old cells form a protective wall between your nutritious tissues and the outside world.

### Ouch!

The layer of skin beneath the epidermis is called the dermis. It contains the ends of nerves that send messages to the brain, allowing you to process sensations of texture, pressure and temperature. The nerves are what make you feel the burn of a kettle or the silky softness of a pillow.

This feature is not only a form of communication network for your body, but also serves as a form of protection! Because the nerve endings let your brain know when something is hot or spiky, your brain can quickly respond and automatically take you away from the danger.

As well as using nerves for communication, the dermis performs other tasks. Located in the dermis are tiny organs that secrete oil. Also known as sebaceous glands, these organs produce a substance called sebum, which keeps water from soaking into your body or from escaping your squishy insides.

### Deep heat

The deepest layer of skin is called the subcutaneous layer. Its purpose is keeping you comfy and warm, while also being a place to store extra chemical energy. Being made mostly of fat, the subcutaneous layer absorbs shock if you fall down or walk into something. And, when you're cold, it prevents your body from losing heat too quickly.

Another way your body controls your temperature is by controlling the flow of blood. Blood vessels in the subcutaneous layer can constrict to stop warm blood from going near the skin's surface, where heat is easily lost. This also makes tiny muscles pull on your hairs so they stand up straight, which is why you get goosebumps when you're cold!

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### Just the facts

1. What is your body's largest organ?
2. Describe the structure of the epidermis.
3. Name two features of the dermis.
4. How does the subcutaneous layer of skin help keep you warm?

### Big tricky question

5. Goosebumps sometimes appear when we get cold. Why?

**What am I learning?**

Different parts of your body have different amounts of sensitivity.

**SCIENCE WITH A TOUCH****You will need**

- 3 types of fishing line  
(0.128 mm, 0.260 mm, 0.520 mm)
- 3 pens
- Sticky tape
- Scissors

**What to do**

- 1) Cut a 10 cm length of line from each size of fishing line.
- 2) Use sticky tape to fasten one of the lines to the end of a pen, leaving about 5 cm hanging loose from the end.
- 3) Repeat Step 2 for the other two lengths of fishing lines.
- 4) Take the thinnest thread (0.128 mm) and sit next to a volunteer. Ask them to close their eyes and hold out their index finger. Ask them to indicate when they can feel their fingertip being touched.
- 5) Lightly press the thread into their index fingertip, just until the thread bends.
- 6) Fill out the box table below.
- 7) Repeat with the other two threads, and on other parts of the body.

Body area	0.128 mm	0.260 mm	0.520 mm
Index finger			
Back of hand			
Forearm			
Cheek			
Knee			

Choose another two appropriate areas on the body. Predict which threads the volunteer will feel:

Body area	0.128 mm	0.260 mm	0.520 mm

Which areas of the body are most sensitive? Why do you think they are so sensitive?

Which areas of the body are least sensitive? Why do you think they aren't so sensitive?

## LIVING BIG

What is the largest living thing alive today? This is actually a tricky question to answer.

Firstly, words such as 'largest' aren't very specific. We could measure length, such as how tall or long something is. Largest could also describe how much it weighs, as well as its volume.

Secondly, knowing where one living thing stops and another begins can be difficult. Sure, a blue whale is one living thing, but what about a big lump of coral? A coral is made up of thousands of tiny coral polyps living together in an interconnected colony. Does it count as one animal or thousands?

The aspen tree can sprout a large number of genetically identical trunks that look like a small forest. But, they are all connected to a single root system hidden underground. This 'super tree' contains far more wood than the tallest redwoods. One web of aspen roots in the United States weighs an estimated 6000 tonnes and stretches over an area equal to about 1900 tennis courts, giving it a pretty solid claim to the title of 'largest living thing'.

Another contender is a colony of honey mushrooms in the United States, which covers an area equal to nearly 40 000 tennis courts. Scientists are pretty sure that the entire colony is genetically identical, but aren't certain if all of the mushrooms are connected as a single organism.

### When bigger is better

Living life on the large side has plenty of advantages. Bigger animals are less likely to be hunted by predators, and they may be able to hunt other large animals themselves. They could also collect more food for relatively less effort. Bigger plant eating animals can reach further to forage, or – in the case of some populations of elephant – use their bulk to knock trees over.

For animals that need to keep their bodies warm, a larger body size helps them stay toasty in colder climates. One example would be a whale swimming in the freezing waters of the Antarctic.

A larger size also allows room for a longer digestive tract to help break down low quality food, such as tough leaves. Some biologists think this was one of the main reasons why plant eating dinosaurs grew so large.

### The gloomy side to being a giant

So, if being gigantic is so great, why aren't all living things huge? A number of things limit the size of an organism. Many factors relate to a mathematical equation called the square cube law.

This law describes the relationship between an object's surface area and the amount of space it takes up. If an object increases in size, its volume grows more than its surface area. Or, in simple terms: for a bit more skin, you grow a lot more guts.

This means a couple of different things. If you blew a cat up to the size of an elephant, the cat's muscles would need to work harder. It would also take a lot more work to pump blood through its body.

This difference in relative muscle strength between small and large animals is significant. An ant can lift objects around 50 times as heavy as itself. Humans are able to lift about the same as their own body weight. An elephant, on the other hand, can only lift 25 per cent of its own weight.

This is part of the reason why large animals tend to be very stocky – they need thick bones and powerful muscles just to support their mass. Whales can grow to such massive sizes thanks to the fact they live in water, which helps support their large bodies.

## Record breakers

**Largest turtle** – Leatherback turtle  
3 metres long, 916 kilograms

**Largest jellyfish** – Lion's mane jellyfish  
2.3 metre wide bell, tentacles up to 37 metres long

**Longest snake** – Reticulated python  
7 metres long

**Most titanic toad** – Cane toad  
38 centimetres long, 2.65 kilograms

**Most colossal crab** – Japanese spider crab  
Arm span 3.8 metres

**Tallest tree** – Coast redwood  
115 metres tall

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## Monster madness

The square cube law means a number of classic movie monsters don't quite stand up to scientific scrutiny. If they were real, their massive weight would be too much for their body to support and they'd collapse. So, you don't ever need to worry about Godzilla or King Kong knocking down your house.



## A square meal

### You will need

Find an assortment of fruit of different shapes and sizes, including grapes, bananas, and melons.

### What to do

- 1) Work out a way to measure and record each fruit's volume (hint: 1 mL of water has a volume of 1 cm<sup>3</sup>).
- 2) Work out a way to measure and record their surface area in cm<sup>2</sup>. (hint: try finding a way to use graph paper).
- 3) Compare the surface area and volume of your fruit. How much more surface area is on an apple than on a grape? How much more volume does the apple have than a grape?
- 4) Does this support the square-cube law?



## MEAT AND VEG

To get their daily dose of nutrients, animals eat and digest plants and other animals. Plants typically absorb their nutrients from soil, but not all soils are rich in nutrients. To survive, some plants have evolved into carnivores!

### Building bodies

Nutrients are chemicals that build and help maintain an organism's body. One group of chemicals that is vital for life is called amino acids.

Strings of amino acids called proteins form the backbone of many of the structures that make up life on Earth. These complex molecules grab, twist, glue and break other chemicals like tiny machines, building and maintaining living cells and tissues.

Animals can make a number of these amino acids. However, some – called essential amino acids – need to be absorbed from the food animals eat. Different animals have different essential amino acids, but a large number are made in plants. No matter what, you can't avoid eating your greens.

### Nitrogen cycle

Like most of life's chemicals, amino acids are compounds made of carbon, oxygen and hydrogen. But, they also need nitrogen (N<sub>2</sub>) to link them into the chains that form proteins.

While the atmosphere is mostly made up of nitrogen, it's not a form that can be easily converted into amino acids. So plants need to get their nitrogen from somewhere.

The flow of nitrogen from one living thing to the next is part of an ecosystem's nitrogen cycle. But, not all ecosystems have the same cycles.

### Plants with bite!

Some soil is dirt poor when it comes to nitrogen. Just as many animals eat plants to get their nitrogen, some plants have been forced to turn the tables. They eat little critters.

The Venus flytrap is the most famous of these 'carnivorous plants'. The flytrap evolved in an

environment in which the soil was nutrient poor. So, the species began to develop certain mechanisms that allowed it to lure and capture live prey.

The centre of the trap's 'leaf' is coloured pinky red, which entices passing insects. As soon as an insect lands on the plant, a tiny hair triggers the leaf to close, forming an inescapable trap.

If the insect isn't able to free itself in time, the plant begins to secrete a fluid containing enzymes. The enzymes speed up the decomposition of the insect and allow the flytrap to take in the nutrients that it needs. After about ten days, the trap reopens, ready to catch more unsuspecting prey.

A variety of carnivorous plants grow all around the world, each of which has adapted to specific environmental conditions. Some rainforest plants use sticky fluids to trap their prey. Others use spiky hairs to imprison their dinner and slowly digest it. Some plants, like the sundew, use sticky protrusions to ensnare insects that happen to touch them.

### Potty mouthed plants

A bat in Borneo uses a certain species of carnivorous plant as a toilet! Researchers think they are spotting evolution in action as they investigate the strange digestive habits of this unlikely pair. The Raffles' pitcher plant features a long, funnel like opening, which it uses to lure and capture prey. Insects make their way into the funnel and get stuck in the fluid inside.

Bats in the area have begun to use these plants as resting spots, because they provide natural protection. The thing is, the bats will often leave a present behind for the plant to digest. Some pitcher plants are now receiving more than 30 per cent of their nutrients from bat dung.

Scientists are watching carefully to see if the plants begin to make themselves more attractive to bats. This would indicate that, as a species, the plants are reacting to new sources of food.

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## BOTTLED GARDEN

### You will need

- Large plastic soft drink bottle
- Scissors
- Sticky tape
- Sand
- Potting soil, compost, peat moss
- Small plants
- Worms

### What to do

1. Remove the label from your bottle.
2. Cut around the wall of the bottle about a third of the way down from its opening. Keep the lid.
3. Place a layer of sand in the bottom of the bottle.
4. Spoon the soil into the bottle and fill it until it is around 1/3 full.
5. Poke a hole in the soil with your finger or stick and add plants or seeds. Water the soil well at first, but rarely thereafter unless no moisture condenses on the inside of the terrarium top.
6. Put a few worms into the soil.
7. Place the top of the bottle back on and seal with sticky tape. You can also use the top or bottom of another bottle for extra height.

### What's happening?

You have made a small ecosystem. For an ecosystem to survive there must be microorganisms in the soil and healthy plants.

A terrarium is like a small Earth and can show us how elements such as land, water, air, animals and plants interact and change together. It is a system, which is a group of elements that function together as a whole.

The survival of the plants and animals in this terrarium depends on the conditions inside the bottle. If the plants and animals can maintain their environment inside the bottle, they will be able to grow.

### What am I learning?

Elements such as water, carbon and other elements cycle through healthy ecosystems.

### Applications

Plants can modify their immediate environment. For example, a rainforest tree may shed leaves and bark that creates a soft, rich layer of soil underneath. This encourages other plants and animals to grow, helping the trees to recycle their nutrients. How well the plants in the terrarium can modify their environment will determine how well they can inhabit their ecosystem. The climate in the terrarium is an important factor in the development of a small ecosystem.

Climate change is already having an impact on plants and may alter the structure of plant communities around the world. Species that are particularly vulnerable to climate change include those with limited growing areas and dispersal abilities.

Several plant species are already adjusting to local climate warming by shifting their ranges toward the poles or higher elevations.

Many plant species are also responding to climate change by advancing the onset of leaf burst, flowering and fruiting, and delaying leaf drop. The growing season of some plants is also lengthening.

### Extend yourself

Can you find a way to link several ecosystem bottles together? If you seal the bottles fully, how long will the plants last?

Try making one bottle an aquarium, using snails and waterweed.

### Research

What is a biosphere?

## OUR LIVING FAMILY TREE

If you had to guess, which pair would you pick as being more closely related: the cauliflower and the Brussels sprout? Or, the African elephant and the Asian elephant?

Despite their huge difference in looks, it turns out that the cauliflower and the Brussels sprout are more closely related than the two species of elephant. Scientists have classified both of these vegies in the genus *Brassica* and the species *oleracea*, giving them the two-part name of *Brassica oleracea*.

Even though African and Asian elephants look similar, they are three different species. Of the African elephants, the African bush elephant is classified as *Loxodonta africana* and the African forest elephant as *Loxodonta cyclotis*. Asian elephants are *Elephas maximus*.

So, how do you draw the line between species? Often it comes down to whether the organisms can breed and produce offspring that can do the same, but it's not a hard and fast rule. It's a tricky business for scientists to work out how living things are related and how to classify them. The techniques scientists have used have also changed over the years.

Eighteenth century professor of botany, Carl Linnaeus, journeyed throughout Sweden to collect and observe different plants and animals. He observed their similarities and differences and put them into groups. These groups were used to give the organisms a two-part name, now known as binomial nomenclature. The basics of his naming system are still used by scientists today.

In the 19th century, Charles Darwin proposed a theory to explain the rich variety of organisms in the world. In basic terms, his theory of evolution can be put something like this:

- organisms are locked in a struggle for survival
- organisms with the best adaptations are more likely to survive and reproduce, and have more babies
- more useful adaptations are more likely to become more common in a population.

Based on their knowledge of evolutionary theory, scientists can create a branching tree diagram that describes how the characteristics of a population of organisms change over time. The diagrams also show that different groups of organisms can have a common ancestor where the branches of the evolutionary tree split.

We now know that adaptations that can be passed down are often represented in an organism's genes. Today, scientists can use the patterns of change in the DNA of genes to reconstruct the history of an organism and its genes.

In recent years, genetic analysis by an international team of scientists settled a dispute over whether or not African elephants – once classified as the same species – were actually two species. They had a common ancestor 2.5–5 million years ago, about the time when the ancestral line between humans and chimpanzees split. Furthermore, the two species of African elephants are as genetically distinct as Asian elephants and mammoths.

By comparing physical and genetic clues, scientists can better organise scientific research and the great family tree to which we belong. It helps us understand where we – and the living world around us – have come from, as well as where we're going.

*The Helix* June – July 2012



### Just the facts

1. Which is more closely related; the cauliflower and the Brussels sprout? Or, the African elephant and the Asian elephant?
2. What is the scientific name for cauliflower?
3. What is a simple way scientists divide a group of related animals into two species?
4. What is a common ancestor?

### Big tricky question

5. The image below is a common way of representing evolution. Is it a good representation? Explain your answer.

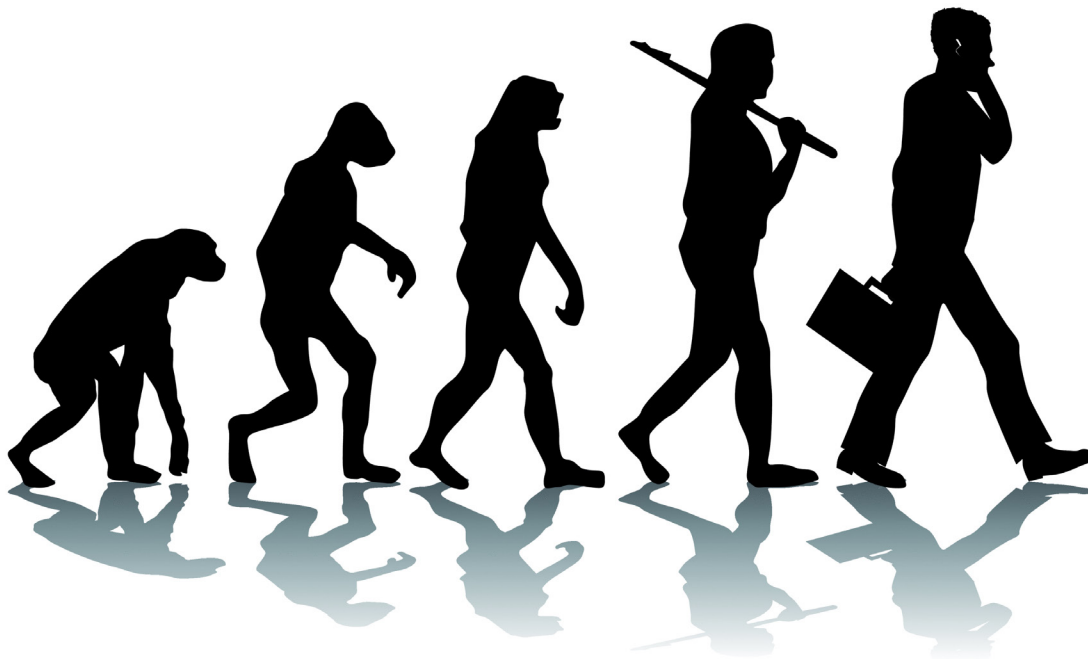


Image: Thinkstock

## PET DINOSAURS

Want your own dinosaur as a pet? Palaeontologist Jack Horner does. Last year, Jack revealed his plans to create his own dinosaur by playing with DNA – the instructions for making a living thing.

In the story Jurassic Park, the DNA of dinosaurs is extracted from blood-sucking mosquitoes trapped in amber. The reality is that it is very difficult to extract blood that may contain dinosaur DNA from a trapped insect. You are much more likely to get the DNA of the insect itself.

Jack investigated getting DNA from dinosaur fossils, and was part of a team that successfully extracted soft blood vessels from the fossilised skeleton of a Tyrannosaurus rex. Even then, they still could not find dinosaur DNA.

So, Jack is now investigating dinosaur descendants: birds! The theory is that over millions of years birds have evolved from dinosaurs. This means that in chicken DNA there may be instructions left over that were once used by dinosaurs. By activating these instructions, it is already possible to make a chicken grow teeth. Other instructions may make the chicken form a tail, change the wings to claws, and so on.

Jack's 'chickenosaurus', as he has called it, won't be exactly like an extinct dinosaur, but a chicken with ancient features. However, it is still a way for us to learn about evolution.

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### A is for atavism

Can you come up with crossword definitions for these words, and then use them in a crossword puzzle of your making? You can add other 'genetic' words.

Atavism:

Vestigial:

Gene:

Mutation:

Inherit:

Adenine:

Extinct:

Chromosome:

**Discuss:** Using what you know about evolution, discuss which came first, the chicken or the egg?



## CONSEQUENCE WHEEL

### What to do

Jurassic Park explored the consequences of creating dangerous, long extinct animals.

Not all dinosaurs were huge, carnivorous beasts. Most were smaller, and behaved like birds.

What might the consequences be of bringing back an extinct animal? Use the consequence wheel below. Write a consequence of recreating an extinct animal in the first circle. Can you think of something that could occur as a result of this consequence? Write it in the outer circle.

